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ABSTRACT

The importance of learning and study strategies in fostering academic achievement has generated a demand for assessing these behaviors. The Learning and Study Strategies Inventory-High School version (LASSI-HS) is one of the most popular of these assessment devices. This study analyzed the second order latent structure of the inventory, using a sample of 1,645 students, and tested it through a confirmatory factor analytic model. The hypothesized model of the LASSI-HS with three correlated factors and unique factor loadings demonstrated a good fit to the data. The resulting model of the LASSI-HS was subsequently used in a more complex model of academic success with the addition of an indicator of verbal and mathematics achievement as measured by the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test (PSAT/NMSQT) results and high school grade point average (GPA). The resulting model also indicated a good fit to the data with the LASSI-HS having a direct effect on GPA as well as a mediating effect through PSAT verbal achievement. The factor structure of the LASSI-HS and model of academic achievement also demonstrated invariance with respect to grade level. (Contains 2 figures, 7 tables, and 18 references.) (Author/SLD)

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Strategic Learning Abilities as a Predictor of Academic Achievement

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Abstract

The importance of learning and study strategies in fostering academic achievement has generated a demand for assessing these behaviors. The Learning and Study Strategies Inventory-High School version (LASSI-HS) is one of the most popular of these assessment devises. The current study analyzed the second order latent structure of the inventory, using a sample of 1,645 students, and tested it through a confirmatory factor analytic model. The hypothesized model of the LASSI-HS with three correlated factors and unique factor loadings demonstrated a good fit to the data. The resulting model of the LASSI-HS was subsequently utilized in a more complex model of academic success with the addition of an indicator of verbal and math achievement as measured by the PSAT/NMSQT and high school grade point average. The resulting model also indicated a good fit to the data with the LASSI-HS having a direct affect on GPA as well as a mediating affect through PSAT verbal achievement. The factor structure of the LASSI-HS and model of academic achievement also demonstrated invariance with respect to grade level.

There is little debate concerning the positive influences that learning and study strategies have on academic achievement. As a result of this positive impact, several programs have been developed that attempt to aid the student in the awareness of their own learning processes (Brown, Bransford, Ferrara & Campione, 1983; Flavell, 1979; and Rohwer & Thomas, 1989). In addition to knowledge of strategies, it is also important to account for the influence of motivation because the awareness of a strategy is of little use if there is no motivation to use it (Pintrich & Johnson, 1990). In response to the importance placed on the teaching and implementation of learning strategies a need to assess these skills arose. The scales that emerged differed with respect to their focus, such efforts included the Learning Process Questionnaire (Briggs, 1987), the Learning and Behavior Scale (Scott, McDermott, Green & Francis, 1988), the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia & McKeachie, 1991) and the Learning and Study Strategies Inventory (Weinstein, Schulte & Palmer, 1987). The Learning and Study Strategies Inventory (LASSI) is primarily targeted at an adult population, however, an additional form (LASSI-HS) has also been adapted for use in high schools (Weinstein & Palmer, 1990). The LASSI and LASSI-HS are the most widely implemented learning strategy assessments in use today (Murphy & Alexander, 1998). The LASSI is used in a descriptive as well as prescriptive manner. For example, LASSI scores can be used to examine the outcomes of a strategy skill building intervention or can be used to identify students who need additional assistance in various skill areas. As such, LASSI scores can be used to determine an optimal learning environment for the student, or they can be used to assess the effectiveness of a learning strategies intervention program.

With the widespread use of the LASSI comes the need to test the measurement properties of the instrument. In a study by Schumacker, Sayler & Bembry (1995) the relationship between

the LASSI and academic achievement was investigated. The results indicated the LASSI could be used to identify students who would encounter academic difficulties in an early college entrance program. In another study by Tallent-Runnels, Olivarez, Lotven, Walsh, Gray, and Irons (1994) the LASSI was used to investigate differences between gifted and average ability students. The results suggested the high achieving students scored higher on several subscales, with anxiety being the most dominant subscale to discriminate between these two groups.

Another series of studies investigated the underlying factor structure of the LASSI. Olejnik and Nist (1992) identified a three factor solution from the LASSI's 10 subscales. They initially conducted an exploratory factor analysis from half of their sample that was used to hypothesize a three factor structure as indicated in Table 1. They subsequently used the other half of the sample to test the fit of their model through a confirmatory factor analysis. The three factor model was judged as the best fit for the data. The identified factors were labeled 1) effort related activities, 2) goal orientation and 3) cognitive activities. Olivarez and Tallent-Runnels (1994) conducted a similar analysis on the LASSI-HS where they also found a three factor model as the best fit for their data. In addition, this study also investigated the stability of the LASSI's latent structure across different ethnic groups. They compared the latent structure of the LASSI for a predominately Anglo-American ethnic background and a predominately Mexican-American ethnic background. The confirmatory analysis indicated an equally good fit for both ethnic groups. The labeling for these three factors although similar to those described in Olejnik and Nist (1992) was slightly different. They were identified as 1) affective/effort related activities 2) anxiety arousing and 3) cognitive aspects/activities. Although both studies identify a three factor solution as the best overall fit to their data, they do report slightly different factor

loading patterns in the attitude, concentration, and selecting main ideas subscales as indicated in table 1.

In an effort to confirm the LASSI's latent structure and further test its stability, Olaussen and Braten (1998) administered the instrument to samples of American and Norwegian college students. As with the two previous studies the samples were analyzed individually using exploratory followed by confirmatory analysis. The resulting factor structure for the American and Norwegian students was the same and generally consistent with prior research, although the factor loading patterns were slightly different (see Table 1). In another investigation of the stability of the LASSI latent structure across different groups, Murphy and Alexander (1998) investigated the latent structure of the LASSI with a sample in Singapore. Surprisingly, the latent structure reported by Murphy and Alexander (1998) was not consistent with the previously described studies. Murphy and Alexander (1998) reported that 7 subscales load on factor 1 with 5 others loading on multiple factors. The confirmatory analysis of the three factor model indicated a GFI of .80 which was lower than the GFI of .921 reported by Olejnik and Nist (1992) and .894 (sample 1) and .814 (sample 2) by Olivarez and Tallent-Runnels (1994). A potential cause for the differences noted in Murphy and Alexander (1998) was attributed to the culture of the sample used (all girls in a private Singapore school). Raising the question of potential model invariance across different groups.

The present study attempts to further an understanding of the Learning and Study Strategy Inventory's underlying latent structure, and linking this latent structure to measures of academic achievement. As we noted earlier, the converging evidence point towards a three factor structure for the LASSI. Although the studies previously cited are based on relatively small sample sizes (n=143 to 264), the present study attempted to supplement the literature by

sampling a significantly larger number of high school students (Gorsuch, 1983). Thus, are strategy was to attempt to replicate the generally accepted three factor model with a larger more diverse sample size using the LASSI-HS. Since the LASSI-HS has developed norms for each high school grade we will investigate the factor structure for both the 10th and 11th grade in an effort to determine if the latent structure is invariant with respect to grade level. Finally, we attempted to fit the resulting LASSI structure into a more complex cognitively rich model. The model was used to describe the influence of the LASSI on academic success as measured by GPA. In addition, ability measures in math and verbal as measured by the Preliminary Scholastic Achievement Test (PSAT/NMSQT) were also incorporated into the model. This model, we believe, gives a clearer picture not only of the LASSI's latent structure but also its relationship to academic success.

Method

Participants

A sample of high school students was taken from 11 locations around the United States. Only students who had taken the PSAT/NMSQT in the October 1996 administration were included in this study. The tenth grade sample consisted of 858 students and the 11th grade consisted of 791 students. Local teachers for these schools assisted in administering the questionnaires, each administrator was given detailed instructions provided by the experimenters.

Instrument

The LASS-HS is an adaptation of the LASSI for adults designed to assess a student's learning and study strategy thoughts and behaviors that contribute to academic success. The inventory is a self report instrument and consists of 76 items which comprise 10 subscales: Attitude (ATT), Motivation (MOT), Time Management (TMT), Anxiety (ANX), Concentration

(CON), Information Processing (INP), Selecting main ideas (SMI), Study Aids (STA), Self Testing (SFT), and Test Strategies (TST) (Weinstein and Palmer, 1990). Students estimate the degree to which a statement is indicative of their learning experience by indicating their selection from 1 (Not at all like me) to 5 (Very much like me). The test manual reports coefficient Alpha reliability estimates ranging from .68 (Study Aids) to .82 (Anxiety). Use of the total score in reporting results is considered overly restrictive. Rather, the use of each subscale score is recommended to provide a comprehensive picture of the relative strengths and weaknesses the student has in a given area (Weinstein, 1987).

Procedure

Teachers from selected schools were asked to administer the LASSI-HS in their respective classrooms. All students in the class were allowed to take the LASSI-HS, however, only the data from students who had also taken the PSAT/NMSQT the semester before were retained for subsequent analysis.

Results

Descriptive Statistics

Statistical analyses were conducted separately for the 10^{th} and 11^{th} grade samples due to norming differences based on each grade level. Table 2 contains the means and standard deviations for the 10 LASSI subscales. Note that although the two grades are the same in terms of GPA, the 11^{th} grade scored significantly higher than the 10^{th} on the PSAT math $t(1,1647) = 9.31$ $p<.001$ and verbal $t(1,1647) = 7.61$ $p<.001$ sections. There were no significant differences within grade for the PSAT math and verbal sections.

In order to derive a better understanding of the raw scores for the LASSI we also indicated their percentile equivalents in tables 3 and 4 for the 10^{th} and 11^{th} grade norms

respectively. The percentiles for both grades cluster around the 50th percentile. The 10th grade percentiles range from a low of 40th for Attitude and Self Testing to a high of 55th for Anxiety. The 11th grade percentiles range from a low of 45th percentile for Attitude, Time Management and Self Testing to a high of 60th for Anxiety. LASSI subscales scores that have a high magnitude are uniformly considered better than low scores irregardless of the subscale description. For example, a high score on anxiety indicates the student is reporting a low level of anxiety.

Reliability Analysis

The LASSI-HS manual (Weinstein and Palmer, 1990) reports coefficient alphas that range from .68 (Study Aids) to .82 (Anxiety and Concentration). In the current sample reliability coefficients for both groups (10th and 11th grade) demonstrated similar or higher coefficient alphas. The tenth grade's reliability coefficients ranged from .71 (Selecting Main Ideas) to .86 (Concentration) the eleventh grade coefficients ranged from .70 (Study Aids) to .86 (Concentration). Reliabilities for the whole test were also high with .95 for the 10th grade and .94 for the 11th. These reliability coefficients are consistent with the users manual as well as previous research and demonstrate an acceptable level of internal consistency for each subscale.

Validity Analyses

Exploratory Factor Analyses 10th grade

The LASSI-HS users manual (Weinstein and Palmer, 1990) is a 76 item questionnaire comprised of 10 distinct subscales. In an effort to determine the underlying latent structure of the inventory we conducted a factor analysis on the 10 subscales. The ten subscales were factor analyzed using principal components extraction with an oblique rotation. This analytic procedure utilizing an oblique rotation was conducted based on the observation that the factors

were somewhat correlated (see Table 5). The principal components procedure extracted two factors with eigen values greater than one. However, based on previous research and upon inspection of the scree plot it was determined that three factors should be extracted rather than two. The resulting factors explained a total of 76.5 percent of the variance. Table 5 displays the factor loadings of each subscale on these three factors. This factor pattern is consistent with that reported by Olivarez and Tallent-Runnels (1994). The identity of these factors it not perfectly clear. As indicated by Olivarez and Tallent-Runnels (1994), Factor 1 may represent some form of affective or effort related activity that possesses some attitudinal attribute. This factor probably has the least to do with specific strategies or tactics used in studying. We would also agree that factor 3 is somewhat cognitively oriented, due to its stress on active learning procedures. Finally, although factor 2 appears to have some goal directed influences, it is probably best characterized as a form of metacognitive understanding due to its self evaluation component.

Exploratory Factor Analyses 11th grade

An identical analysis was performed on the 11th grade sample. Again the principal components extraction with oblique rotation indicated a three factor solution similar to the 10th grade see Table 5. Therefore, it appears the number of factors and their corresponding factor loadings are consistent across grade level for the LASSI-HS and with previous research. This apparent structure and consistency across grade levels was subsequently tested through confirmatory factor analysis.

Confirmatory Factor Analysis - LASSI-HS

Although there is convergent evidence in the literature for a three latent variable factor structure to the LASSI, there are differences in terms of which subscales comprise these factors.

The cause of these discrepant results is unclear. The instability of these results may be attributed to a modest sample size or the differences in sample characteristics. In an effort to test the hypothesized factor structure obtained from the previous exploratory factor analysis a confirmatory factor analysis was performed. The EQS structural equation modeling program developed by Bentler (1995) was used to determine the fit of our hypothesized models. EQS reports a comparative fit index (CFI) which indicates the fit of a user specified model to the observed data. In addition EQS also reports the LISREL Goodness of Fit Index (GFI) and a measure of the model's standardized residuals, indicated by the standardized Root Mean Squared Residual (RMR). Fit indices (CFI and GFI) in the low .90s and above indicate the model is a very good fit to the data.

Subscale scores were used as the basic unit of measurement in the previous EFA as well as the present confirmatory factor analysis. The purpose for using these scores instead of the individual items was necessary to obtain convergence with more complicated factor structures that would have been extremely difficult with all 76 items. In an effort to further justify the use of these subscale scores as the basic unit of measurement we tested their individual factor structures by grade. A summary of their fit statistics, Comparative Fit Index (CFI) and Goodness of Fit Index (GFI) are presented in table 6. All of the subscales have an acceptable fit with respect to at least one of these fit indices. However, they do not fit equally well as evidenced by the lower fits associated with the subscales for self testing and study aids. However, given the overall fits of these subscales we felt reasonably confident that the subscale scores could be used in subsequent analyses.

A null model for the second order LASSI structure was initially specified which would serve as a baseline for subsequent models. This model specifies unique factors for each LASSI

subscale and represents a worst case scenario in terms of overall model fit which resulted in χ^2 = 9242.269 df = 45. The second model run was a fully saturated model in which all subscales were allowed to load on each correlated factor. This model represents a best case scenario in terms of fit due to the minimal constraints imposed. The resulting model yielded χ^2 = 159.495 df = 12 with CFI and GFI = .98 with a standardized RMR = .02. Although this fit is excellent the model is not very parsimonious because it does not specify any unique factor loadings. Therefore, a third model was specified to test if the factor loading pattern indicated in the exploratory analysis where LASSI subscales were allowed to load on only one factor would still allow for an acceptable fit to our data. The resulting model yielded χ^2 = 732.695 df = 32 with a CFI = .93 and a GFI = .92 with standardized RMR = .07. Although the increase in Chi Square between Models 2 and 3 is significant the overall fit indices are still very good and we are willing to sacrifice this change in chi square from the saturated model for the sake of the more parsimonious third model. This third model tells us something about the specific factor structure of the LASSI while still maintaining a very good fit to the data. A fourth model was run to test for the influence of the correlated factors in model three. The fourth model specifying uncorrelated factors yielded a chi square of χ^2 = 1854.235 df = 35 with CFI = .80 and GFI = .83 with a standardized RMR = .27. The additional constraint of uncorrelated factors resulted in a significant reduction in fit causing the two indices to drop below tolerable levels. We would therefore specify the third model, depicted in Figure 1, as the best fit to our data.

LASSI Model Invariance

Because the LASSI manual reports different percentiles for high school students based on their grade and the expected differences in PSAT score based on grade the LASSI was also tested for factor structure invariance across grade level. Since it is difficult to statistically

compare model fits across multiple runs with different groups a simultaneous analysis was conducted in EQS. The simultaneous run requires the specification of a model for each grade while holding various sets of parameters equal across groups. The factor structure of model three in the previous analyses was run simultaneously for the 10^{th} and 11^{th} grades initially with no equality constraints imposed on both the factor loadings and covariances. The resulting statistics served as a baseline for increasingly constrained simultaneous analyses and yielded a χ^2 = 773.373 df = 64 and a CFI = .92. The second set of simultaneous models specified the factor loadings across grade as equal while leaving the covariances to be estimated independently. The resulting model yielded fit statistics of χ^2 = 800.338 df = 74 and a CFI = .92. In order to demonstrate that the factor loadings were invariant across groups the difference in chi squares between this model and the baseline should not be significant. The comparison of the baseline model and the second model constraining factor loadings resulted in $\Delta\chi^2$ = 26.965 df = 10 $p<.001$. This difference was not significant and indicates the two models are invariant across grade level with respect to factor loadings. The next comparison focussed on model invariance with respect to factor correlations. A simultaneous analysis was conducted with both factor loadings and covariances constrained. The resulting χ^2 = 809.793 df = 77 with CFI = .92 was compared to the model with only factor loadings constrained. The resulting $\Delta\chi^2$ = 9.455 df = 3 was also not significant indicating the models were also invariant with respect to factor correlations between grade levels. Therefore, the LASSI seems to possess the same factor structure for both 10^{th} and 11^{th} grade students.

LASSI in a model of Academic Achievement

Due to the invariance of the LASSI across grade level the entire sample was included in a more complex academic model. Using the factor structure depicted in figure 1, a more

representative model of the LASSI as a tool for predicting academic achievement was investigated. In this model the three LASSI subscales, two PSAT subscores (math and verbal) and high school grade point average (GPA) were used to explain a richer model of academic performance. This representation of academic performance was tested in a confirmatory factor analytic model. The corresponding fit for this model was very good χ^2 = 1002.384 df = 53 with a CFI = .92 and GFI = .92 with standardized RMR = .07. An analysis of the individual measurement equations indicated that four paths in the model were not significant. These included all paths from the LASSI to PSAT math and the path from LASSI factor 3 (Cognitive/Active Learning) to GPA. Removal of these paths did not significantly affect the overall fit of this model χ^2 = 1009.301 df = 57 with CFI = .92 and GFI = .92 with standardized RMR = .07. Therefore, this more parsimonious model was retained and is depicted in figure 2 along with the corresponding standardized coefficients for the maximum likelihood solution.

Invariance of Academic Achievement Model

In order to test for the invariance of this model across grade level a simultaneous analysis of the 10th and 11th grades was conducted. In a similar procedure to the LASSI test of invariance a baseline model was specified with no constraints across grade level. The resulting fit statistics indicated a χ^2 = 1081.467 df = 114 with a CFI = .92. The next model run was identical to the baseline except all factor loadings were constrained to be equal across grade level. The resulting model yielded a χ^2 = 1118.872 df = 132 with CFI = .92. The difference test for these models indicated the two were not significantly different from one another $\Delta\chi^2$ = 37.405 df = 18 p<.001. This result indicated the two models of academic performance did not differ from one another, across grade levels, in terms of their factor loadings. In order to determine if this factor invariance also held for the covariances another model was specified which constrained the

factor loadings as well as covariances equal to one another across grade level. The resulting χ^2 = 1132.583 df = 135 with CFI = .92 was compared with the previous model and the difference between them $\Delta\chi^2$ = 13.711 df = 3 p<.001 was not significant. Therefore, it seems the factor structure for academic performance does not vary across grade level.

Discussion

The Learning and Study Strategies Inventory has demonstrated a consistent pattern in terms of latent factor structure. The invariance of this factor structure has been demonstrated in a wide variety of samples and settings, and was reaffirmed in this study as well. While comparing groups of different cultures, socio-economic status, and now grade levels, the LASSI has demonstrated a consistent number of factors across these different groups. Although the consensus for a three factor model (and the identity of these factors) is relatively strong, there does not seem to be any clear consensus concerning the loading pattern of subscales on these factors (though this may be a sample dependency issue). In addition, the difficulty reported by Murphy and Alexander (1998) in replicating the LASSI factor structure and the subscale intercorrelations make the LASSI more complicated to interpret especially when using the individual subscale scores for diagnosis or assessment. Murphy and Alexander (1998) make a valid point with reference to a potentially confounding situation with respect to the ascending or descending nature of the items. The LASSI like most scales of its type present items that are worded either positively or negatively, the positive items are scored normally and the negative items are reverse coded to allow the highest score (5 on this scale) to be the most effective instance of that study behavior. It has been demonstrated that negatively worded items can result in inconsistent dimensionality and the creation of factors based principally on the reverse coding attribute of a set of items (Magazine, Williams, & Williams, 1996). This problem can typically

be avoided if the reverse coded items are randomly distributed throughout the subscales. However, this does not seem to be the case for the LASSI used in this study. Table 7 indicates the pattern of reverse coded items to regular items for each LASSI subscale. Evidently the LASSI contains subscales that are dominated by either one of these types of items. A line of further research could focus on this potential confound by comparing the current LASSI form with a reworded version to see if the two contained similar factor structures.

Even with these potential shortcomings, the LASSI factor structure still holds up very well at the individual subscale level and second order latent variable level. With improvements to some of the weaker subscales the fit statistics for the LASSI should improve to even higher levels.

As noted earlier, the strategic learning abilities measured by the LASSI are presumed to be integral to academic achievement. And, indeed, the complex academic model tested in this research supports this assumption. The models tested here all reported good fits to the data. For example, all paths in the model were significant with the exception of the relationship between factor 3 (Active Learning) and GPA and between the LASSI's latent factor structure and PSAT math, suggesting that the LASSI has a more direct affect on GPA and verbal achievement as measured by the PSAT than it has on math achievement as measured by the PSAT math.

The structure of this model of academic achievement can be characterized as possessing two components. The first part, depicting a cognitive ability structure, is represented by the relationships between GPA and both PSAT subscales. Although the path between verbal achievement and GPA is not as strong as that between math and GPA there is still a strong mediating relationship between verbal and math achievement. The second component of the overall model of academic achievement involves the interplay of learning and study strategies

and their role on academic performance. In this characterization the first two LASSI factors are directly associated to GPA. Although, all three LASSI factors are not significantly associated with math achievement they are still all mediated by verbal achievement.

The significant impact that "Affective/Effort" related activities have on GPA is not surprising. This may be attributed to the fact that GPA is often calculated in a less rigid, often subjective manner. Teachers, for example, are often willing to take behaviors like effort and attitude into consideration and allow for extra credit to help bring student's grades up to an acceptable level. Verbal performance on the PSAT is more a matter of strict cognitive achievement. For example, a student may be very motivated to do well on the test, however if they lack the knowledge to answer the questions they will perform poorly. Given this scenario one would expect the path between factor 1 (Affective/Effort) and PSAT verbal and math to be at or close to zero. This pattern is consistent with the path between factor 1 and PSAT math however, the path between factor 1 and PSAT verbal seems significant and negative. On the surface it may appear that higher scores on factor 1 translate into lower scores on PSAT verbal or vice versa. In an effort to understand the cause of this counterintuitive result the sample was split into high and low verbal ability groups based on PSAT verbal median score. The resulting groups had a verbal mean of 38.98 sd = 5.67 (low achievement group) and 56.20 sd = 7.1 (high achievement group). The corresponding unweighted composite scores representing the subscales that comprise factor 1 were 104 and 105.6 for the low and high achievement groups respectively. This indicates that although the two groups differ by over two standard deviations with respect to verbal achievement they are virtually the same in terms of their factor 1 scores. Therefore, it appeared as though the low achievement group may have been biased in terms of their self reports on this factor. Both groups generally produced similar Affect/Effort scores, however,

since the factor has little actual relevance to PSAT verbal performance the low achievement group produced factor 1 scores that were high relative to their PSAT verbal scores causing a negative relationship. The path coefficients in the model act just like partial regression coefficients indicating the effects of the predictor while partialling out other predictors. When a regression between PSAT verbal and factor 1 was run alone the resulting beta was insignificant, however, when the variance explained by factor 2 (metacognition) and factor 3 (cognitive activities) were partialled out, the coefficient became negative. Therefore, the partialling out of these cognitive influences may have served to amplify the biases inherent in the relationship between factor 1 and PSAT verbal.

This model of academic achievement can serve as a starting point to explore even more complex relationships that relate to academic success in the educational system by using other measures of academic proficiency such as local standardized tests or graduation rate. The inclusion of additional indicators will no doubt add complexity to the current model but this is necessary to more adequately capture the elements that foster and inhibit academic performance.

References

Briggs, J. (1987). *Learning Process Questionnaire (LPQ): User's manual*. Melbourne: Australian Council for Educational Research.

Brown, A. L., Bransford, J.D., Ferrara, R.A., & Campione, J.C. (1983). Learning, remembering and understanding. In J.S. Flavell & E.M. Markman (Eds.), *Handbook of child psychology* (vol. 3, 4th ed.). New York: Wiley.

Bentler, P.M. (1995). *EQS Structural Equations Program Manual*. Encino, CA: Multivariate Software, Inc.

Flavell, J.H. (1979). Metacognition and cognitive monitoring:A new era of cognitive developmental inquiry. *American Psychologist*, 34, 906-911.

Gorsuch, R.L. (1983). *Factor Analysis*. Hillsdale, NJ: Lawrence Erlbaum and Associates.

Magazine, S.L., Williams, L.J., & Williams, M.L. (1996). A confirmatory factor analysis examination of reverse coding effects in Meyer and Allen's Affective and Continuance Commitment Scales. *Educational and Psychological Measurement*, 56, 241-250.

Murphy, P.K. & Alexander, P.A. (1998). Using the Learning and Study Strategies Inventory-High School Version with Singaporean females: Examining psychometric properties. *Educational and Psychological Measurement*, 58, 493-510.

Olaussen, B.S. & Braten, I. (1998). Identifying latent variables measured by the Learning and Study strategies Inventory (LASSI) in Norwegian college students. *The Journal of Experimental Education*, 67, 82-96.

Olejnik, S. & Nist, S.L. (1992). Identifying latent variables measured by the Learning and Study Strategies Inventory (LASSI). *The Journal of Experimental Education*, 60, 151-159.

Olivarez. & Tallent-Runnels, M.K. (1994). Psychometric properties of the Learning and Study Strategies Inventory-High School Version. *The Journal of Experimental Education*, 62, 243-257.

Pintrich, P.R., Smith, D.A., Garcia, T., McKeachie, W.J. (1991). *A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ)*. Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning.

Rohwer, W.D., & Thomas, J.W. (1989). Domain specific knowledge, metacognition, and the promise of instructional reform. In McCormick, Miller and M. Pressley (Eds.), *Cognitive strategy research: From basic research to educational applications* (pp.104-132). New York, Springer Verlag.

Schumacker, R.E., Sayler, M., & Bembry, K.L. (1995). Identifying at risk gifted students in an early college entrance Program. *Roeper Review*, 18(2), 126-129.

Scott, D.H., McDermott, P.A., Green, L.F. & Francis, J.M. (1988). *Learning Behaviors Scale and the study of children's learning behaviors: User's manual*. San Antonio, TX: Psychological Corporation.

Tallent-Runnels, M.K., Olivarez, A., Lotven, A.C.C., Walsh, S.K., Gray, A., & Irons, T.R. (1994). A comparison of learning and study strategies of gifted average-ability junior high students. *Journal of Education for the Gifted*. 17, 134-160.

Weinstein, C.E. (1987). *Learning and Study Strategies Inventory (LASSI): User's Manual*. Clearwater, FL: H & H Publishing.

Weinstein, C.E. & Palmer, D.R. (1990). *LASSI-HS: Learning and Study Strategies Inventory-High School Version*. Clearwater, FL: H & H Publishing.

Weinstein, C.E., Shulte, A.C., & Palmer, D.R. (1987). *Learning and Study Strategies Inventory (LASSI)*. Clearwater, FL: H & H Publishing.

Table 1. Summary of previous research on factor loading patterns for second order LASSI

Olivarez and Tallent-Runnels (1994)		
Affective/Effort	Anxiety-arousing	Cognitive
TMT	ANX	INP
CON	SMI	STA
ATT	TST	SFT
MOT		
Olejnik and Nist (1992)		
Effort	Goal	Cognitive
ATT	ATT	ATT
MOT	CON	SMI
TMT	ANX	INP
CON	TST	STA
	SMI	SFT
Olaussen and Braten (1998)		
Effort	Goal	Cognitive
MOT	CON	SMI
TMT	ATT	INP
CON	TST	STA
ATT	ANX	SFT
TST	SMI	
	INP	

LASSI-HS Scale Labels: Attitude (ATT), Motivation (MOT), Time Management (TMT), Anxiety (ANX), Concentration (CON), Information Processing (INP), Selecting main ideas (SMI), Study Aids (STA), Self Testing (SFT), and Test Strategies (TST).

Table 2. Means and standard deviations for LASSI subscales by grade

10th				
	Min	Max	Mean	SD
ATT	11.00	40.00	29.86	5.87
MOT	8.00	40.00	29.56	6.27
TMT	7.00	35.00	19.64	5.51
ANX	8.00	40.00	26.38	6.24
CON	8.00	40.00	24.83	6.80
INP	8.00	40.00	25.38	6.10
SMI	5.00	25.00	17.73	3.85
STA	8.00	40.00	22.47	5.93
SFT	8.00	40.00	24.39	6.11
TST	8.00	40.00	28.50	5.90
GPA	3.00	12.00	8.55	1.84
PSAT-V	20.00	74.00	45.71	9.83
PSAT-M	20.00	80.00	45.96	9.88
11th				
	Min	Max	Mean	SD
ATT	10.00	40.00	30.95	5.44
MOT	10.00	40.00	30.29	5.73
TMT	7.00	35.00	19.71	5.50
ANX	8.00	40.00	27.09	6.63
CON	8.00	40.00	25.02	6.55
INP	8.00	40.00	26.31	5.82
SMI	5.00	25.00	18.14	3.82
STA	8.00	40.00	23.28	5.58
SFT	8.00	40.00	25.05	5.67
TST	8.00	40.00	28.84	5.96
GPA	3.00	12.00	8.76	1.87
PSAT-V	20.00	80.00	49.69	11.26
PSAT-M	20.00	80.00	50.89	11.49

Where GPA range = 0(F) – 12(A+).

Table 3. Raw score equivalents of percentiles on 10 LASSI subscales for 10th grade sample.

Percentile	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST	Percentile
99	40	40	34	38	38	38	25	35	38	39	99
95	39	39	31	36	36	36	24	32	36	38	95
90	38	37	29	34	34	34	23	30	34	36	90
85	37	36	28	32	32	32	22	29	32	35	85
80	36	35	27	31	31	31		28	31	34	80
75	35	34	25	30	30	30	21	27	30	32	75
70	34			29	29	29	20	26	29		70
65		33	24	28	28	28		25	28	31	65
60	33	32	23	27	27	27	19	24	27	30	60
55	32	31	22	26	26	26		23		29	55
50	31	30	21	25	25		18		26	28	50
45		29	20	24	24	25	17	22	25	27	45
40	30	28		23		24		21	24	26	40
35	29		19	22	23		16	20	23		35
30	28	27	18	21	22	23	15			25	30
25	27	26	17	20	20	22		19	22	24	25
20	26	24	16	19	19	21	14	18	21	22	20
15	24	23	14	17	17	20	13	17	19	21	15
10	22	22	13	16	16	19	12	15	18	20	10
05	19	19	11	13	13	17	10	14	16	17	05
01	14	14	09	10	10	13	09	11	12	13	01

Table 4. Raw score equivalents of percentiles on 10 LASSI subscales for 11th grade sample.

Percentile	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST	Percentile
99	40	40	34	38	38	38	25	36	38	39	99
95	39	39	31	36	36	36	24	33	36	38	95
90	38	37	29	34	34	34	23	31	34	37	90
85	37	36	28	33	33	32		29	32	35	85
80		35	27	31	31	31	22	28	31	34	80
75	36	34	25	30	30	30	21	27	30	33	75
70	35			29	29	29		26	29	32	70
65	34	33	24	28	28		20	25	28	31	65
60		32	23	27	27	28	19		27	30	60
55	33	31	22		26	27		24		29	55
50	32	30	21	26	25	26	18	23	26	28	50
45	31	29	20	25	24			22	25		45
40		28		24		25	17		24	27	40
35	30		19	23	23	24	16	21	23	26	35
30	29	27	18	22	22	23		20		25	30
25	28	26	17	21	20	22	15	19	22	24	25
20	26	24	16	19	19	21	14	18	21	23	20
15	25	23	14	18	17	20	13	17	19	21	15
10	23	22	13	16	16	19	12	16	18	20	10
05	19	19	11	14	13	17	10	14	16	17	05
01	14	14	09	10	10	13	09	12	12	13	01

Table 5. Three factor solution for 10 LASSI subscales 10th and 11th grade sample.

10th	Factor 1		Factor 2		Factor 3	
	Pattern	Structure	Pattern	Structure	Pattern	Structure
Attitude	.591	.744	.105	.358	.330	.544
Motivation	.694	.823	.166	.444	.195	.450
Time Management	.865	.871	.071	.388	-.061	.244
Anxiety	.056	.258	-.209	-.109	.812	.811
Concentration	.769	.855	.012	.322	.238	.503
Info Processing	-.098	.293	.902	.881	.160	.213
Select Main Ideas	.039	.436	.378	.464	.744	.794
Study Aids	.163	.414	.810	.856	-.150	-.015
Self Testing	.311	.573	.748	.860	-.049	.130
Test Taking Strategies	.195	.479	-.009	.144	.834	.901

Factor Correlations

Factor	1	2	3
1	1.000		
2	.374	1.000	
3	.344	.096	1.000

11th	Factor 1		Factor 2		Factor 3	
	Pattern	Structure	Pattern	Structure	Pattern	Structure
Attitude	.694	.765	.006	.250	.224	.439
Motivation	.783	.847	.108	.371	.092	.344
Time Management	.858	.864	.068	.343	-.052	.220
Anxiety	.075	.227	-.130	-.056	.844	.836
Concentration	.772	.851	.007	.279	.248	.488
Info Processing	-.166	.190	.899	.862	.203	.227
Select Main Ideas	.098	.409	.199	.298	.792	.839
Study Aids	.234	.434	.777	.839	-.171	-.033
Self Testing	.374	.584	.676	.795	-.032	.141
Test Taking Strategies	.204	.466	.005	.142	.841	.904

Factor Correlations

Factor	1	2	3
1	1.000		
2	.326	1.000	
3	.310	.084	1.000

Table 6. Summary of fit statistics for 10 LASSI subscales

Subscale	Chi Square	df	CFI	GFI
ATT	115.682	20	.96	.98
ANX	115.569	20	.97	.98
CON	139.195	20	.98	.98
INP	166.967	20	.96	.98
MOT	246.102	20	.94	.96
SFT	512.342	20	.84	.91
SMI	80.203	5	.96	.98
STA	334.829	20	.84	.95
TMT	239.832	14	.90	.96
TST	143.659	20	.96	.98

Table 7. Number of ascending and descending items by LASSI subscale.

	Ascending Items	Descending Items
ATT	0	8
MOT	5	3
TMT	2	5
ANX	1	7
CON	1	7
INP	8	0
SMI	2	3
STA	8	0
SFT	8	0
TST	0	8

Figure 1. Second order Factor structure for 10 LASSI subscales.

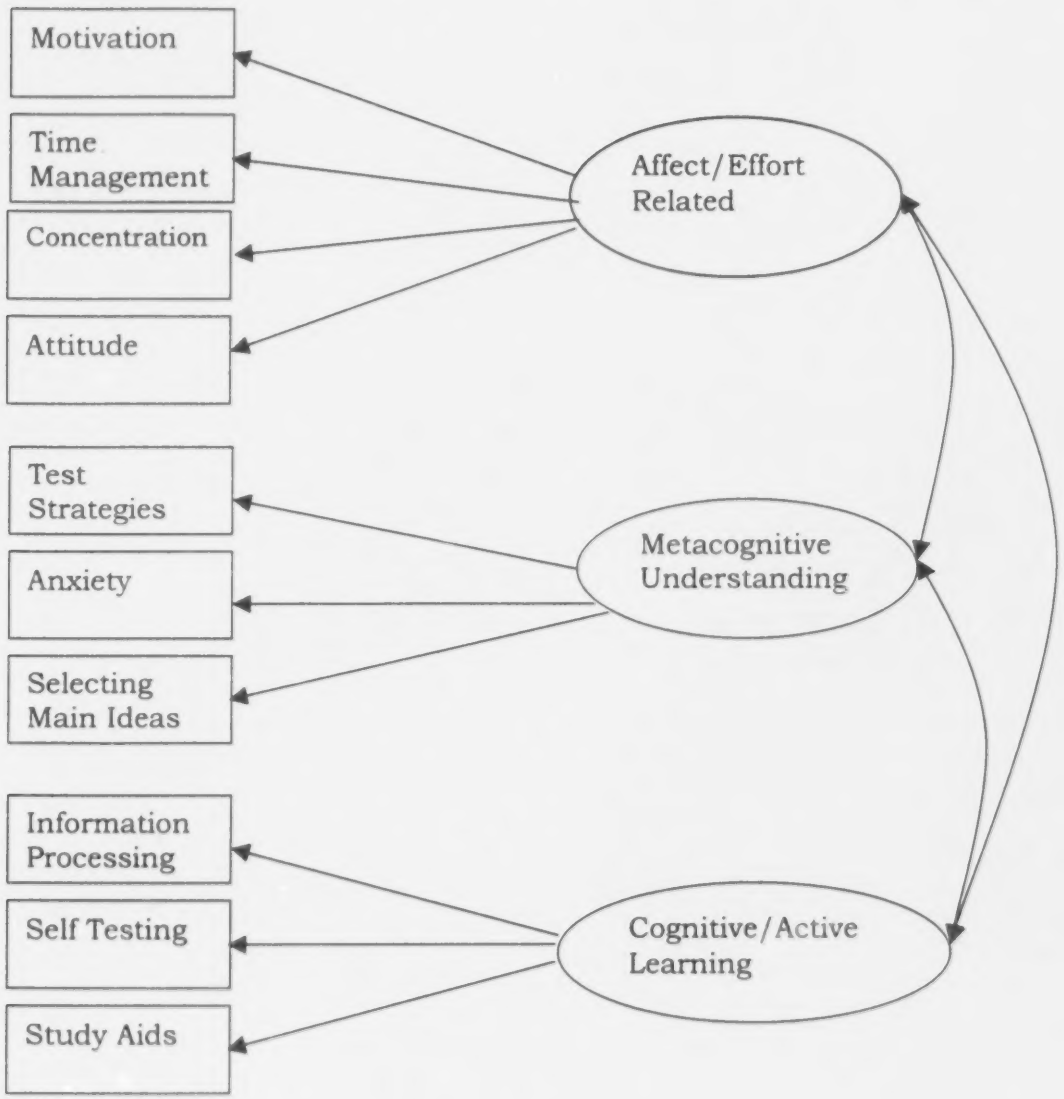

Figure 2. Final latent structure for LASSI in model of academic success.